Impact Estimate of Palos Verdes Offshore Routing

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Organization: F046
Project: Airspace Analysis & Design

Background

- Residents of Palos Verdes would like turboprop overflights moved offshore
  - Extra flying distance certainly results
  - Is there a delay cost as well?
- Possibility exists of critical backup of departures, leading to gridlock on airport surface
  - To model the impact on ground operations and arrivals of moving a departure fan, TAAM is preferred tool
- Estimate of the impact of proposed changes on users is needed

The Bottom Line

- **Increased flying distances is a minor impact**
- **Increased ground delay time is at least 80% of total cost**
- **In millions of dollars per year, using Air Transportation Association cost estimates:**

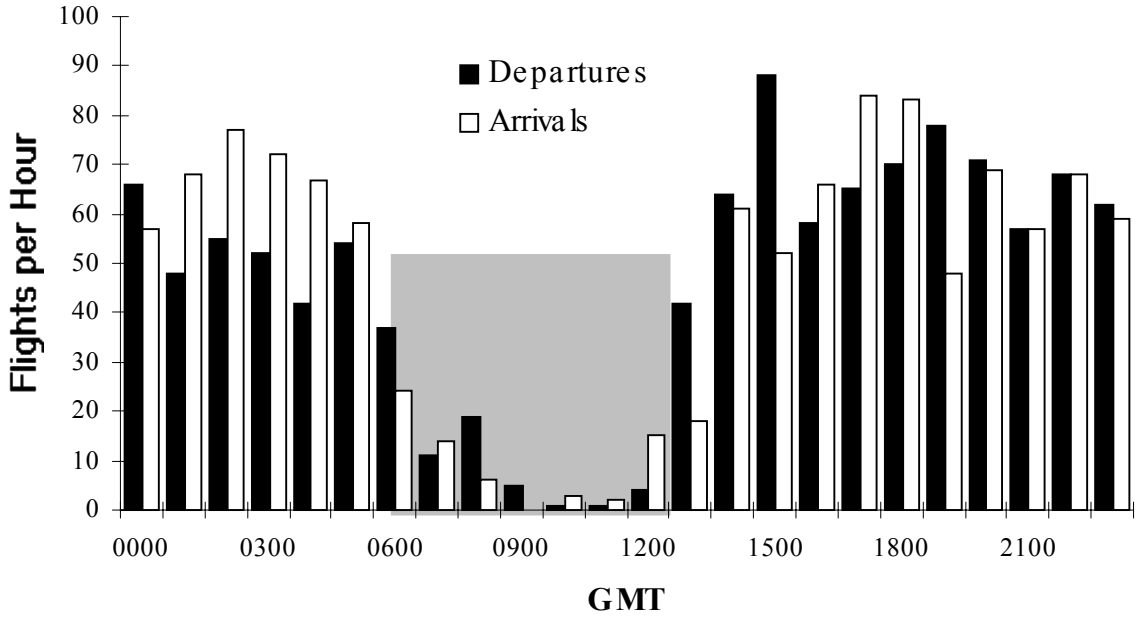
	Ground	Airborne	Total Penalty
1 mile offshore	$34.8	$1.1	$35.8
2 miles offshore	$46.4	$5.8	$52.2
3 miles offshore	$58.0	$10.6	$68.5
5 miles offshore	$71.5	$14.2	$85.7

Approach

- Simulate 1 VMC day
  - 0700-2200 local time
  - OAG traffic + ETMS flights for cargo, GA, etc.
  - ZLA sectorization from July 1999 ACES
  - Validate against SCT ARTS trajectories
- Extract metrics
  - Excess airborne time
  - Increased ground delay
- Convert to direct operating costs using data from the ATA

Simulated Traffic

- **Thursday, 26 Aug 1999**
- **Grey period excluded from simulation**



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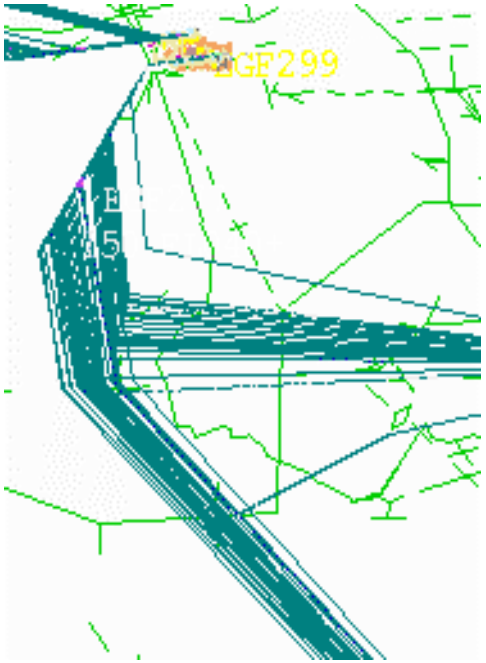
What Was Simulated

- LAX
  - Ground movement
  - Runway assignment rules
    - MIT on inner-runway arrivals
  - Arrival & departure procedures
- SNA, LGB
  - 1 runway only
  - Arrival & departure procedures
- Traffic Flow Management
  - 15 MIT on GMN, DAG, TRM from 1400 to 1700 PST
  - AAR of 84 in VMC, 68 in IMC

What Was Omitted

- Other airports
  - "Pointwise" modelling
- Overflights in TRACON
- Conflict detection and resolution
  - Procedural separation of traffic is assumed

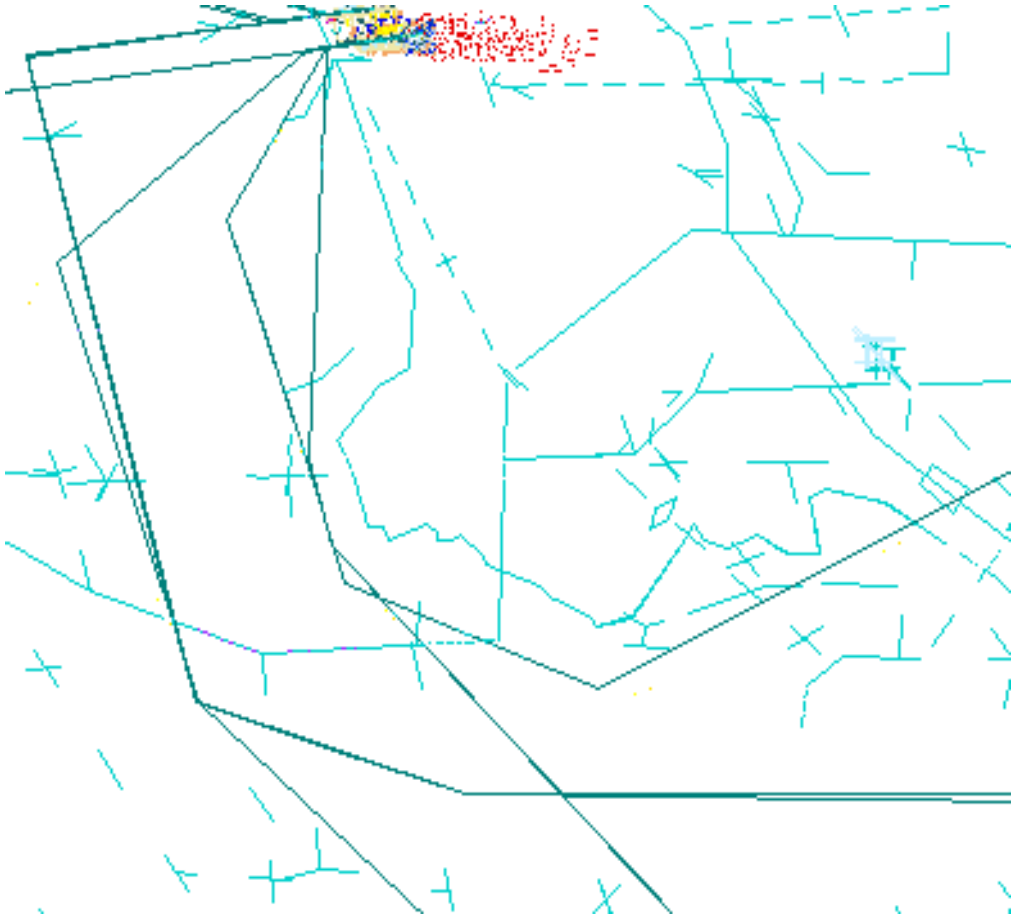
Departure Fans: Current and Simulated



Qualitative Impact of the Offshore Reroute

- The “fan” must now be kept in trail
  - Departure delay is insensitive to the details of the routing
  - Very sensitive to traffic volume
- More in-trail distance must be flown
  - Independent of traffic volume
- SNA departures over DAG must be rerouted
  - In trail with LAX Loop departures
- If aircraft are put more than one mile offshore,
  - TANDY arrivals into LGB, SNA must be rerouted westward

Alternative Departure Fans: 1 Mile Offshore



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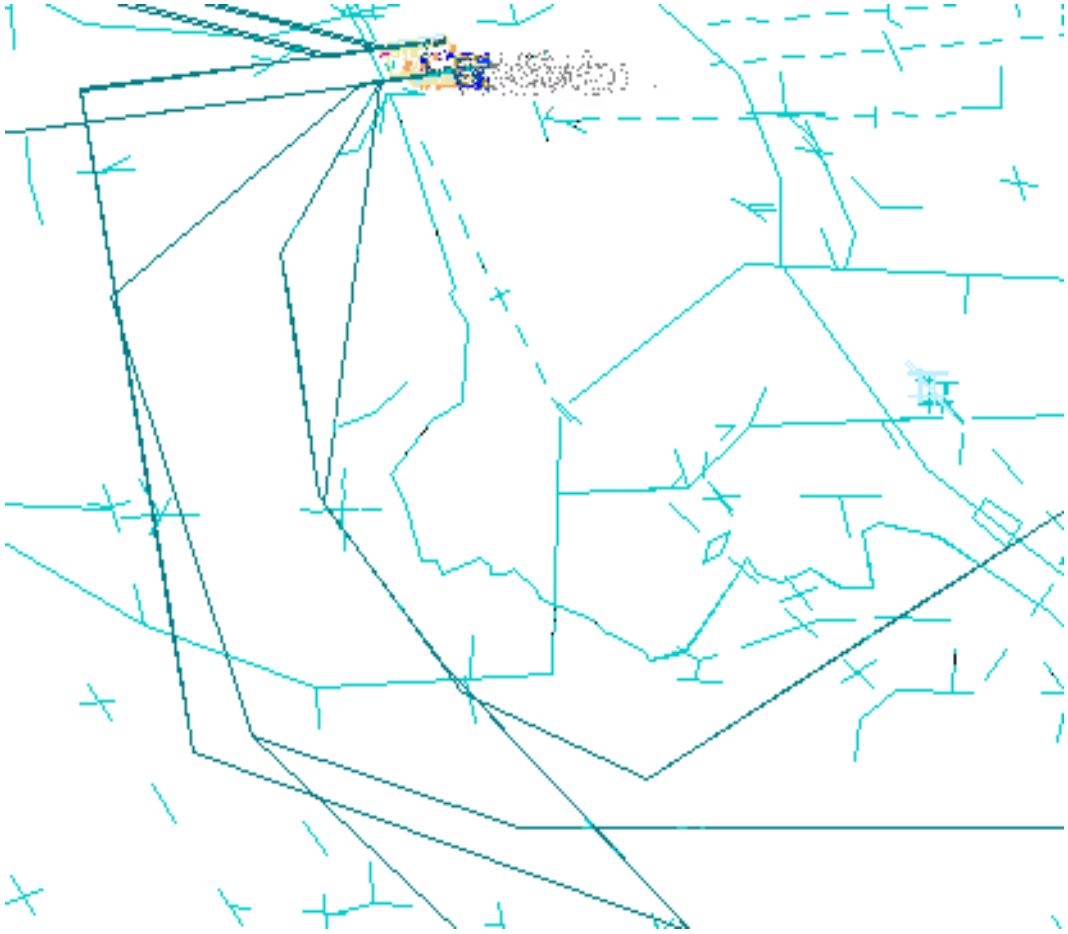
Alternative Departure Fans: 2 Miles Offshore



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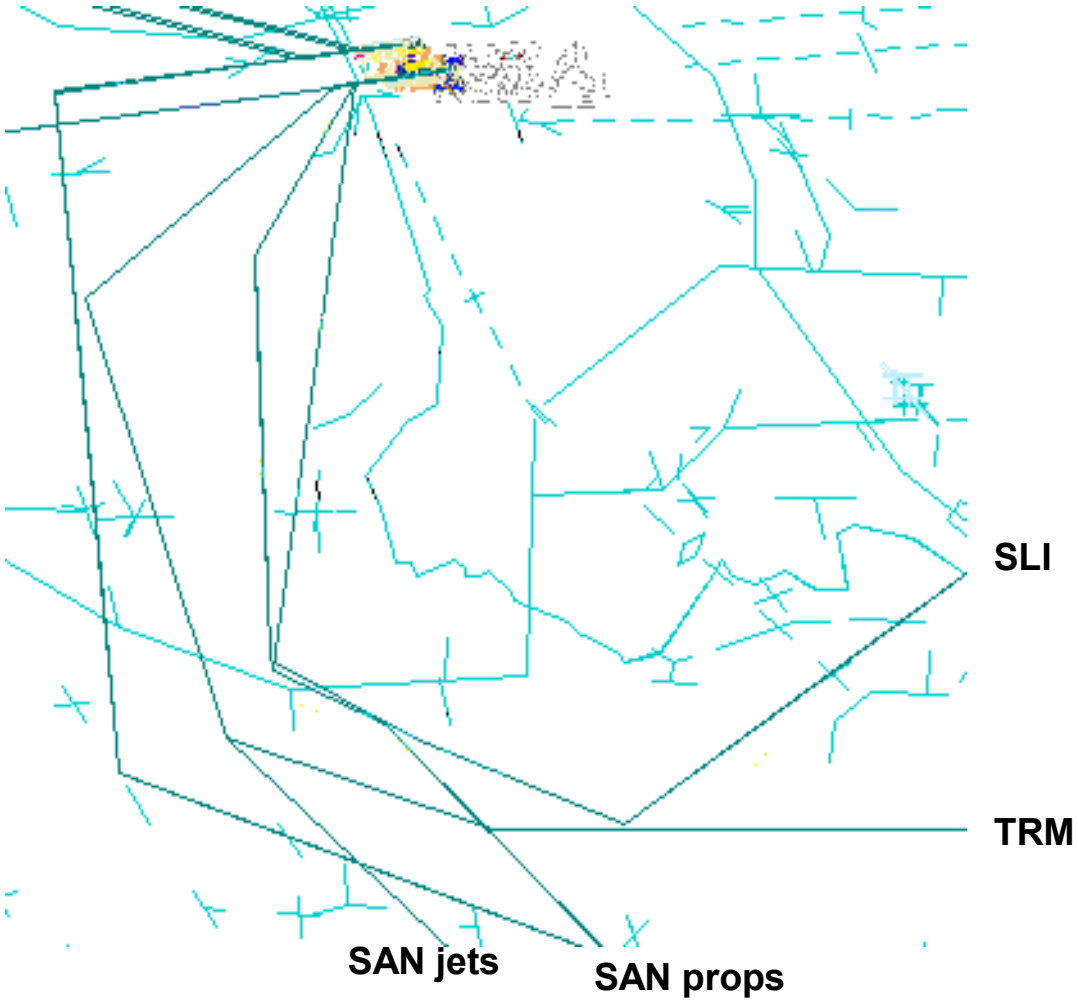
Alternative Departure Fans: 3 Miles Offshore



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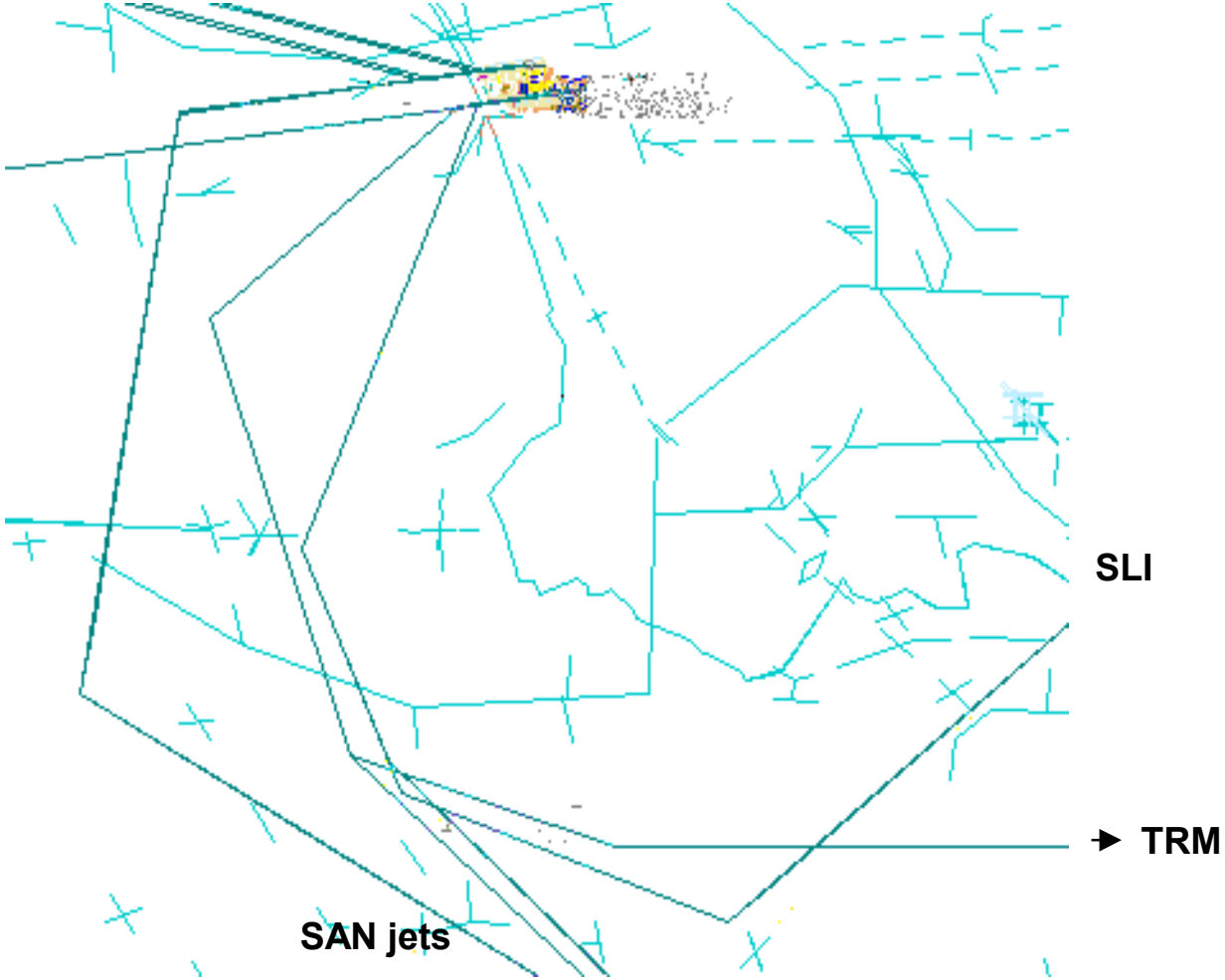
Alternative Departure Fans: 5 Miles Offshore



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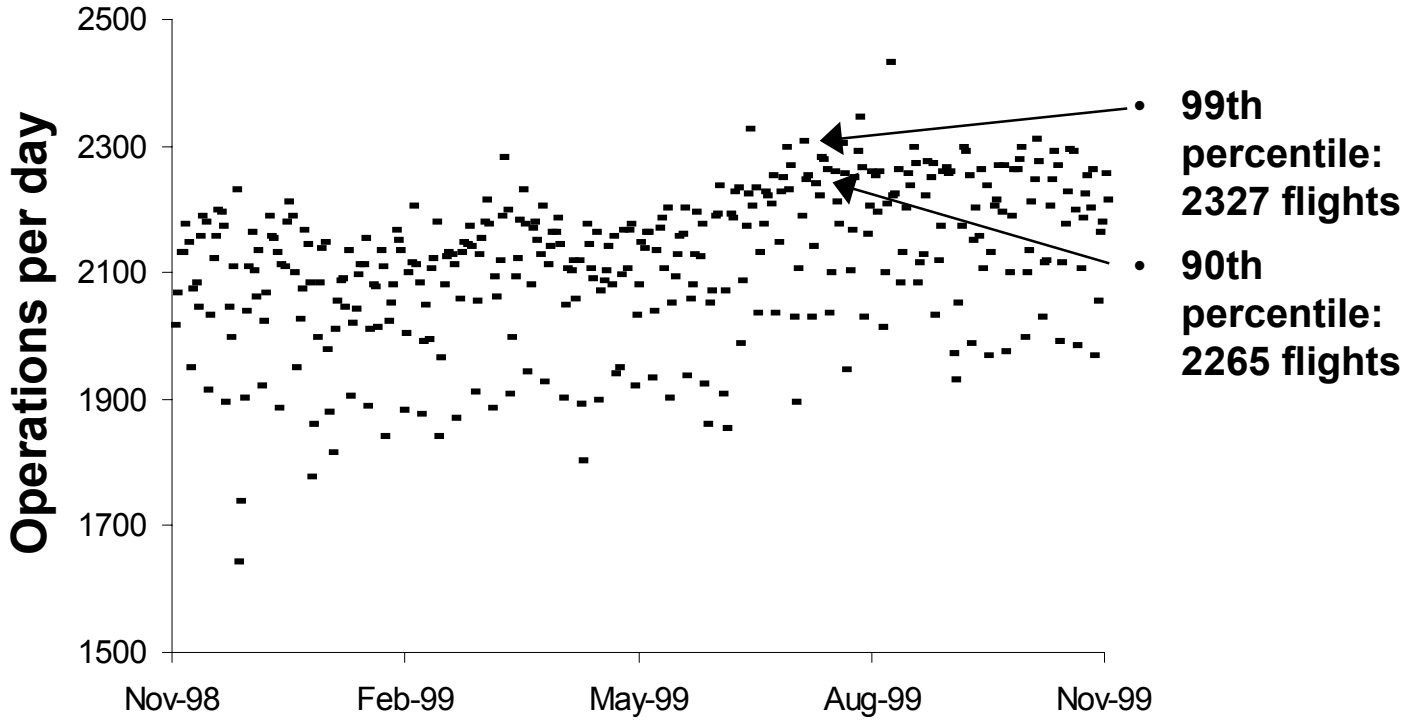
Daily OPSNET Traffic Counts for LAX



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Simulation Results: Qualitative Observations from the 90th Percentile Day

- Queues of aircraft departing 25R seldom reached back to terminal 8 in the baseline; frequently in offshore scenarios
- Offshore routing has no significant effect on arrival delays in VFR
  - Usage of inner runways for arrivals in VFR dropped from 150 to 111 in the simulated period when offshore routing was used
- IFR operations were gridlocked on the airport surface
  - The 90th percentile traffic level can probably not be maintained in IMC, even in current conditions

Calculating Costs

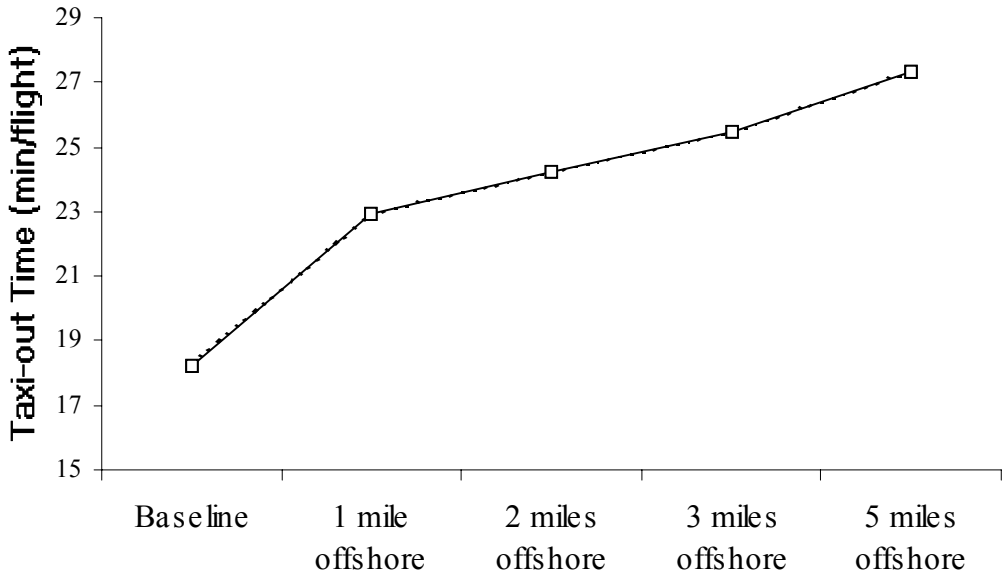
- Include fuel, crew, and direct maintenance
- Air Transport Association estimates that delay costs
  - $23.32/minute at the gate
  - $29.79/minute on the taxiway
  - $46.76/minute in the air
  - All figures in 1998 dollars

Annualization of Penalties

- **OPSNET traffic counts for LAX**
  - **Simulated traffic levels are 90th percentile day for Nov 98 - Nov 99**
  - **Multiply the 90th percentile day by 314 to get annual figures**
  - **Steadily increasing demand means these delay/cost figures may be underestimates**

Simulation Results: Ground Delays

- Taxi-out time is most sensitive metric
- This simulation directed departure delays due to spacing on departure routes to be taken on the taxiway
  - Excessive congestion resulted from taking delays at gate, leading to gridlock



Simulation Results: Ground Delays

- **Using Air Transport Association 1998 cost figures,**

	Mean Taxi-out	Penalty	Per day (min)	Per Year (min)	Cost per Year ($M)
Baseline	18.2	—	—	—	—
1 mile offshore	21.8	3.6	3717	1,168,100	$34.8
2 miles offshore	23	4.8	4956	1,557,466	$46.4
3 miles offshore	24.2	6	6195	1,946,833	$58.0
5 miles offshore	25.6	7.4	7641	2,401,094	$71.5

Simulation Results: Airborne Delays

- **Using Air Transport Association 1998 cost figures,**

		LAX departures	LAX arrivals	SNA departure	SNA arrivals	Daily Total	Annual ($M)
Delay	1 mile	71	0	3	20	72	
	2 mile	317	0	48	49	395	
	3 mile	563	0	93	78	718	
	5 mile	765	2	93	103	963	
Cost	1 mile	$ 3,320	$ -	$ 140	$ 935	$ 3,367	$1.06
	2 mile	$ 14,823	$ -	$ 2,244	$ 2,291	$ 18,470	$5.80
	3 mile	$ 26,326	$ -	$ 4,349	$ 3,647	$ 33,574	$10.55
	5 mile	$ 35,771	$ 94	$ 4,349	$ 4,816	$ 45,030	$14.15

Simulation Results: Cost Impact on Jet Aircraft

	Ground	Airborne	Total Penalty
1 mile offshore	$19.9	$0.7	$20.6
2 miles offshore	$27.3	$4.3	$31.6
3 miles offshore	$34.8	$7.8	$42.6
5 miles offshore	$42.6	$10.5	$53.1

Simulation Results: Cost Impact on Turboprops

	Ground	Airborne	Total Penalty
1 mile offshore	$14.9	$0.3	$15.3
2 miles offshore	$19.1	$1.5	$20.6
3 miles offshore	$23.2	$2.7	$25.9
5 miles offshore	$28.9	$3.7	$32.6

Sensitivity Analysis: Traffic Demand

- 99th percentile day (2327 ops)
  - Baseline shows more delays due to volume
    - Taxi-out time rises from 18 to 25 minutes per flight
    - Arrival delay rises from 12 to 21 minutes per flight
    - Regular blocking of gates by departure queues
  - Offshore scenarios show non-viable operations
    - Hundreds of flights terminated because all runway exits are occupied
    - Simulation breaks down due to excessive traffic
- Possible conclusion: with offshore routes, LAX will no longer have capacity to handle traffic at this level
  - Airport moves smoothly with an AAR of 45
  - 45 * 24 hours = 1080 arrivals/day, which is too few

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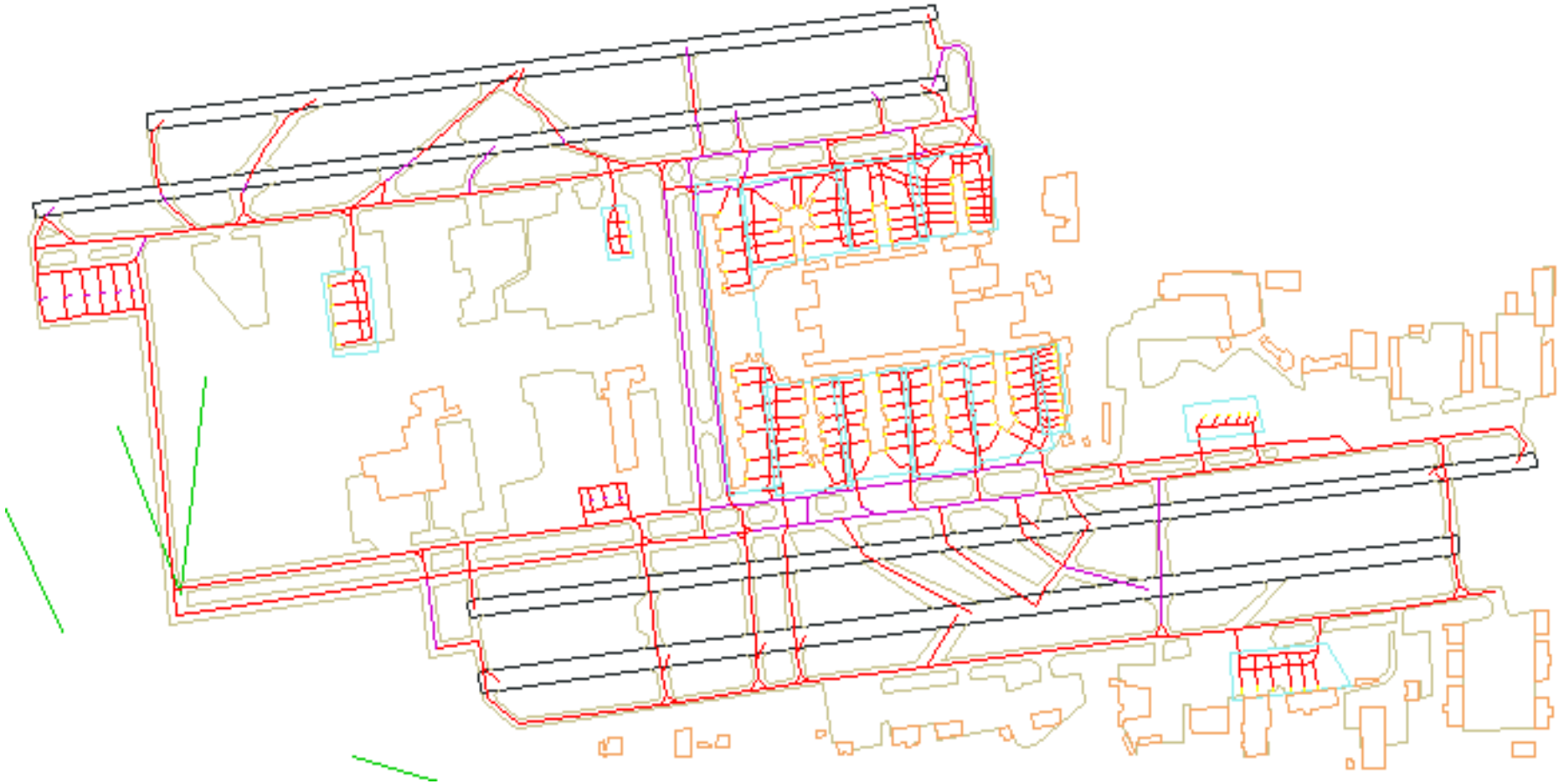
TAAM Simulation Details: Airport Surface



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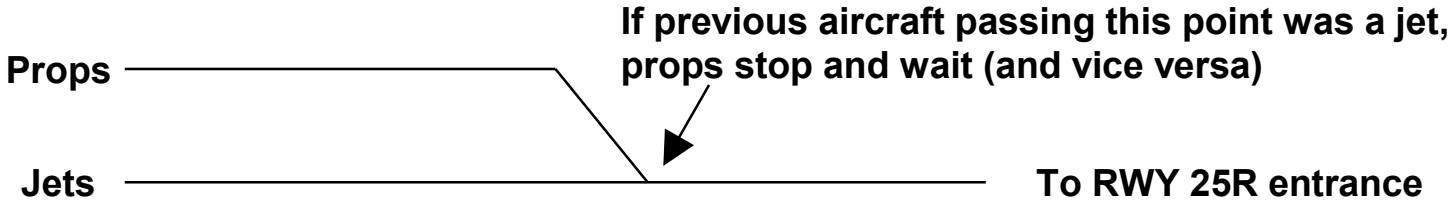
TAAM Simulation Details: Airport Surface

- **Simple gate assignment at LAX**
  - **Major airlines to appropriate terminals**
  - **GA, Cargo away from terminals**
- **Turboprop Shotgun on 25R**
  - **Use Taxiway C for props, B for jets**
  - **Define "stop and wait" rule based on previous aircraft**



Result was typically 3-6 turboprops in a cluster

TAAM Simulation Details: Airspace

- Arrival and departure procedures derived from
  - SCT Standard Operating Procedures
  - Jeppesen DP/STAR plates
    - Altitude and speed restrictions
    - Holding patterns
  - Descriptions by facility personnel
- Results are independent of variations in
  - Radar separation on final from 2.5-3 nmi
  - Lengths of extended downwinds on FIM approaches

TAAM Simulation Details: Modeling the Baseline Turboprop Departure Fan

- Turn to new heading upon reaching specified altitude
- Starting weights of aircraft were randomized
  - Minimum and maximum climb rates from manufacturers' data
- Cross out of LAX Class B airspace above 5000 ft
- Result is a "fan" of departures that do not need to be kept in trail